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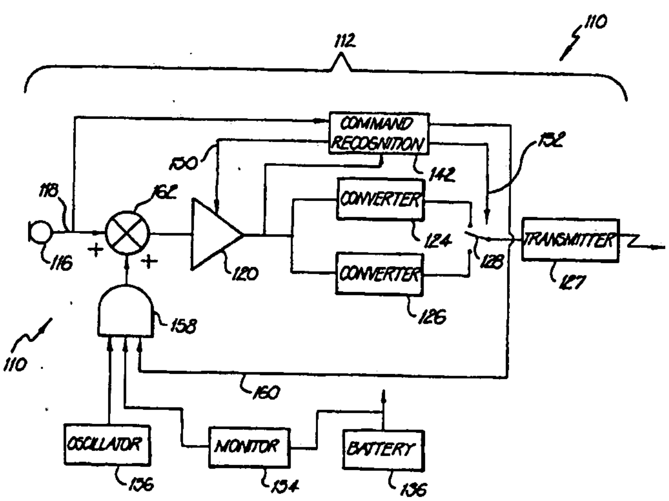

(57) Abstract

A hearing aid device such as a cochlear implant comprising a microphone (116) for receiving ambient sounds as well as spoken or voice commands and for converting said sound into corresponding electrical signals. A processor (142) separates the signal into command signals and voice signals. The voice signals are transmitted to the patient in the usual manner, while the command signals are used to control certain functions of the processor, such as volume control processing criteria selection, or the provision of information such as battery status, the time, the user's body temperature and reminders or notes made by the user. Alarm messages are automatically transmitted to the user when appropriate whereas others are available at a user set time or on demand. The system is customisable allowing for the user to record his/her own messages and to enter commands either by means of a keypad or by speech recognition.

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APPARATUS FOR AND METHOD OF CONTROLLING SPEECH PROCESSORS AND FOR PROVIDING PRIVATE DATA INPUT VIA THE SAME

TECHNICAL FIELD

This invention relates to apparatus for and a method of controlling the operation of devices used to enhance the aural faculties of a person, such as, for example, a cochlear implant.

The invention further relates to a cochlear prosthesis capable of conveying information of interest to the wearer by transmitting said data directly to the wearer in an unobtrusive and private manner. This is accomplished by incorporating the data into the processed sound stimulations which stimulate the user's auditory nerve in the normal course of operation of the cochlear implant.

BACKGROUND ART

Various devices, such as cochlear implants, are being used to assist persons having a chronic aural disability or impairment which cannot be alleviated by external hearing aids. These devices typically include two sections: an external section carried on the user and an internal section which is implanted into the user.

The external section typically includes a microphone for converting ambient sounds into electrical signals, signal processing means for converting the electrical signals into processed signals, and a signal transmitter for transmitting the processed signals to the internal section. The internal section typically includes receiver means for receiving signals from the transmitter, signal processor means for processing the received signals, and stimulating means for stimulating the inner ear of the person, such as the cochlea, in accordance with the received signals.

The external section further includes various manual controls for the operation of the device, such as a volume control, battery checking, and so on. A problem with devices of the kind just described is that, although the

microphone, transmitter and signal processing means are electronic components which are readily miniaturized, the overall size of the external section is still too large because of the manual controls which typically consist of, or are implemented, using mechanical components.

A further disadvantage of the existing systems is that, naturally, the person tends to hide the external section on his person, i.e. in the clothing, so that the impairment is not obvious. However, once the external section is hidden, it is difficult to manipulate its manual controls.

Additionally, the external component of some of the devices may include status indicators, relating to various functions of the device, to the wearer. This technique has several disadvantages. One major disadvantage is that it is relatively conspicuous and counter to the general prosthetic device design objective of presenting as low a profile as possible.

Another disadvantage of this technique is that alarms may go unnoticed by the user. For example, if the alarm is provided as a visual indicator such as an LED mounted on the external component, then if the user wears this external component behind the ear, or in a pocket, the warning indication will not be detected unless a deliberate effort is made to inspect the indicator. Furthermore, the diligent user will regularly check such status indicators only to find that all is well and that there has been no need to have taken the trouble of checking.

A further disadvantage of the present technique is that it lacks flexibility since it is arranged and constructed to monitor and indicate only very specific functions.

It is possible to make use of an audible alarm, for example by means of a small loudspeaker or tone-generator, rather than a visual one, however, this approach also presents problems. A disadvantage of audible alarms is that they may make the wearer overly conspicuous and self-conscious. In addition, the very purpose of the device is to provide assistance to a person who has hearing difficulties. Providing the user with more external sounds,

which he may not hear clearly, can have the unwanted effect of generating confusion and irritation.

Finally, work is being conducted to minimize these devices to a point where the external component is completely eliminated and all its functions are incorporated in a single implanted component. Of course, this type of device is not amendable to the user of either visual or audible alarms.

DISCLOSURE OF THE INVENTION

According to one aspect of the invention there is provided a device for aiding a person having a hearing impairment, said device comprising:

a microphone for converting ambient sounds and commands, including voice commands and other audio signals, to electrical signals;

signal processing means for processing said electrical signals in accordance with control signals;

means for transmitting processed signals to said person; and

command recognition means coupled to said microphone for recognizing said voice commands and wherein said recognition means generates said control signals.

According to another aspect of the invention there is provided a device for aiding a hearing impaired person; said device comprising:

an external section worn by said person; and

an internal section implanted in said person;

said external section including a microphone receiving audio signals and converting them into received electrical signals, signal processing means for processing signals into stimulation signals, transmitting means for transmitting said stimulation signals to said internal section, a battery for generating power to said external section, and means for reporting a status of said battery;

said reporting means including monitoring means for monitoring said battery, signal generating means coupled to said monitoring for generating battery status signals indicative of said status and means for combining

said battery status signals and said stimulation signals for indicating to said person said battery status.

According to a further aspect of the invention there is provided a hearing aid system comprising:

means for receiving ambient and command signals and converting said signals into electrical signals;

means for separating said electric signals into audio signals and command signals;

means for processing said audio signals to generate audio stimulating signals;

means for controlling said processing signals in accordance with said command signals; and

means for transmitting said stimulating signals to the cochlear nerve of a patient.

According to a still further aspect of the invention there is provided a cochlear implant system comprising:

means for sensing ambient sounds and generating in response first electrical signals;

event means for sensing events other than said ambient sounds and generating in response second electrical signals;

means for generating processed signals corresponding to said first and second electrical signals; and

stimulating electrodes for applying said processed signals to an auditory nerve so that the patient can perceive said ambient sounds and receive information regarding said events.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a prior art device;

Fig. 2 is a block diagram of a device according to a first embodiment of the invention;

Fig. 3 is a block diagram of the command recognition module

of Fig. 2;

Fig. 4 is a block diagram of a second embodiment of the invention;

Fig. 5 shows the programming information contained in the memory of the device from Fig. 4;

Fig. 6 is a block diagram of a cochlear implant constructed in accordance with a third embodiment of the invention;

Fig. 7 is a block diagram of a cochlear implant constructed in accordance with a fourth embodiment of the invention;

Fig. 8 is a schematic diagram of the elements of a two-part cochlear implant system constructed in accordance with the invention; and

Fig. 9 is a schematic diagram o the elements of a completely implanted cochlear system constructed in accordance with the invention.

MODES FOR CARRYING OUT THE INVENTION

Referring now to the drawings, and more particularly to Fig. 1, a typical prior art device 10 includes an external section 12 and an internal section 14. The external section 12 includes a microphone 16 which picks up ambient sounds and converts them to corresponding electrical signals on line 18. Line 18 is connected to a manual volume controller 20 shown diagrammatically as a potentiometer. The volume controller output 22 is fed in parallel to a first and a second converter 24, 26 respectively. Each of these converters 24, 26 convert the received signal into cochlea stimulating signals, using certain preselected criteria.

For example, converter 24 may perform the conversion using a criteria which is best suited for signals in a crowded room whereas converter 26 may perform a conversion more suitable for sounds in a more intimate, one-to-one conversation.

A manual switch 28 is used by the person to select the converter most suitable for a particular environment. The converted signals selected by switch 28 are fed to a transmitter 27 to be sent to internal section 14.

Internal section 14 includes a receiver 30, a signal generator 32 and a stimulator electrode 34. The signals from receiver 30 are transformed into suitable cochlea stimulation signals by signal generator 32. These stimulation signals are then transmitted to electrode 34 for stimulating the cochlea.

The system may include other components, such as a battery 36 used to provide power to the subassemblies of section 12. In order to check whether the battery is depleted or not, the person closes a battery test switch 38. This allows current to flow from battery 36 to a LED 40. When the battery 36 is low, the LED 40 will be very dim thus indicating that the battery is depleted and should be replaced.

As previously mentioned, this arrangement is disadvantageous in that it has several manual components, such as switches 28 and 38 as well as LED 40, which make it bulky and difficult to operate, especially if hidden in clothing. In addition, the device cannot be used by a person who is so incapacitated that he cannot use his fingers.

An improved device 110 constructed in accordance with one embodiment of this invention is shown in Fig. 2. Device 110 includes an external section 112 and an internal section which has been omitted since it is preferably identical to the section 14 in Fig. 1. Most of the time, the external section 112 operates in the same manner as external section 12 of Fig. 1. More specifically, a microphone 116 picks up ambient sounds and converts them into corresponding electrical signals on line 118. After amplification by amplifier 120, the amplified signals are fed in parallel to two converters 124, 126. An electronic switch 128 is used to select the output of one of the converters and feed the same to transmitter 127. Power to the whole section 112 is provided by a battery 136.

In addition, section 112 further includes a command recognition module 142 which also receives the signals generated by microphone 116. Module 142 is set up to recognise a plurality of oral commands received from the user via the microphone 116. These commands are used to control the operation of the section 112.

For this purpose, the module 142 includes a memory 143 (shown in Fig. 3) which contains a list of acceptable commands. These commands may include, for example, the following:

VOLUME UP
VOLUME DOWN
CONVERTER A
CONVERTER B
BATTERY

The module 142 further includes a microprocessor 144, a speech recognition circuit 146 and a demultiplexer 148. The electrical signals from microphone 116 are monitored and converted into digital form by speech recognition circuit 146. The microprocessor 144 continuously monitors the signals from the circuit 146 and compares them with a list of commands from memory 143. When a set of signals is recognized as a command by microprocessor 144, the microprocessor issues an appropriate command for controlling the operation of section 112. For example, when the user utters the commands VOLUME UP or VOLUME DOWN, microprocessor 144 issues a corresponding control signal to the amplifier 120 on line 150 to raise or lower its amplification.

If the command CONVERTER A or CONVERTER B is received and recognized, the microprocessor 144 issues a control signal on line 152 to electronic switch 128 to select the appropriate converter 124 or 126.

For the battery check function, a feedback is required to the user. For this purpose, section 112 includes a battery monitor 154, an oscillator 156, a control gate 158 enabled by a control line 160, and a mixer 162.

The monitor 154 generates an output indicative of the status of the battery 136 (i.e., whether the battery output is above or below a certain threshold, or by using other criteria indicative of the status of the battery). This output is used to control gate 158. An oscillating signal of a particular frequency is generated by oscillator 156 and fed to gate 158.

When the BATTERY command is received and recognized, the microprocessor 144 generates an output signal for a preselected time period on line 160 to gate 158. For the period of time that the control signal is on line 160, the gate 158 allows the output of oscillator 156 to propagate to mixer 162, if the monitor 154 indicates that the battery is getting weak or non-operational. As long as the battery 136 is operational or its output is found acceptable by the monitor 154, gate 158 is disabled regardless of the status of line 160. If the battery is found unacceptable, the mixer receives the output of oscillator 156 and superimposes this signal on the signals from the microphone 116. The user hears this superimposed signal and recognizes from its amplitude, pitch, or other characteristic whether the battery 136 is still operational, or requires replacement. Alternatively, the monitor 154 may be used to control the oscillator output directly, for example, by changing its frequency or output amplitude.

Preferably, the commands are stored in memory 143 during a training period, during which the user is asked to voice various commands. Since the voice characteristics of various users are unique or distinctive, the command recognizing module 140 is able to recognize and respond to commands from the user, while similar words from other persons during incidental conversations are ignored. Alternatively, the commands can be selected to be specific words, syllables and/or numbers which are not normally used in conversation. To increase the security of the system, a special command may be assigned to 'wake up' the module 140. Unless this 'wake up' command is received first, the module 140 ignores all signals from the microphone 116.

The embodiment of Fig. 4 pertains to a more advanced device 210 having an external section 212. In this device 210, the signals from a microphone 216 are fed to an A/D converter 270 and the output of the converter 270 is fed to a digital signal processor 272. The signal processor 272 includes programming for performing several functions listed in Fig. 5. These functions include the two conversions, conversion 224, and conversion 226, as discussed with respect to Figs 1 and 2.

The digital signal processor 272 further includes a command recognition function 240 for recognizing commands by the user a s described above, as well as a battery check 254 and an oscillator function 256. The battery check 254 checks the battery 236, and if necessary, enables the oscillator 256. The output of the oscillator is fed to a mixer 262. Thus it can be seen that the embodiment of Figs. 4 and 5 is similar to the embodiment of Figs. 2 and 3 except that it is based on a more sophisticated digital signal processor.

Referring now to Fig. 6, relevant elements of another embodiment of the invention for a cochlear implant system are shown. The system includes a speech module 310, a microphone 312, a speech processor 314 and a microprocessor 316. The module 310 is coupled to a stimulation delivery means 318.

Briefly, the microphone 312 detects ambient sounds and generates corresponding electrical signals. Under the control of the microprocessor 316, these signals are processed by the speech processor 314 which generates processed signals called "tokens" in accordance with a predetermined algorithm. The processed signals are then provided to the stimulation delivery system 318, as described more fully below in Figs. 8 and 9.

Power for the module is provided by a battery and power supply circuitry 336. In the case of a totally implanted device the battery is implanted and is rechargeable by means of a transcutaneous link. In the

case of a system which is not totally implantable, as shown in Fig. 8, the battery is housed in the external unit.

The elements described so far as well known in the art. Typically, the speech processor 314 performs such functions as anti-aliasing filtering, analog-to-digital conversion, feature extraction and so on. A cochlear implant system is described for example, in U.S. Patent No. 4,532,930, which is incorporated herein by reference.

Importantly, the system further includes one or more of the following elements: an ambient sensor 320, a command handset 323, a command decoder 324, an analog-to-digital converter 326, a clock 328, a message source 330 and a summer 303. The message source 330 shown in Fig. 6 consists of message RAM 306 and a speech and tome synthesizer 304 for recording and generating speech signals.

The additional components (some of which are optional) are used to provide various information to the patient which was not directly available to him before. The simplest such information is that provided by the clock 328.

Although this clock may be a separate timing device, preferably it is derived from the same clock that is also used to provide the basic clock signals for the microprocessor 316. In the present invention, the clock 328 is also used to provide the patient with an indication of the current time. The clock 328 makes available to the microprocessor 316 the time when requested, either on demand or periodically, by the microprocessor. The time check may be perceived by the user as, for example, "beeps".

With reference to Fig. 6, a beep may be generated on the hour by the clock flagging the microprocessor at that time. The microprocessor 330 then requests the message source to generate a tone by means of speech synthesizer 304. The tone is fed via connection 302 to the summer 303 where it is mixed with the audio signal from the microphone 312. The combined audio signal is processed by speech processor 314

and delivered to theuser who perceives both the normal hearing information and the time-check tone as a superimposed beep. Alternatively, beeps may be generated according to a grandfather-clock-like scheme with a particular sequence of tones sounding on the quarter hour or other time interval.

In an alternative embodiment of this time-check facility, the memory source 330 may be used to generate a plurality of word messages rather than tones, with each message corresponding to a particular time. For example, one such message may be the spoken words "IT IS ONE PM". the words "IT IS ...PM" would be stored in the message RAM 306. When it is ONE PM, as indicated by the clock 328, the microprocessor 316, using for example a lockup table retrieves the message an insert a speech synthesiser derived word for the hour to produce the string of words 'IT IS ONE PM", the spoken message is then transmitted via connection 302 to the summer 303 and processed and delivered to the user.

However, a more efficient mode is to store and synthesize tokens of post-processed data rather than pre-processed audio signals. This embodiment is depicted in Fig. 7. In this embodiment, the message source 330A consists of a token RAM 310A and a token synthesizer 308A. The token RAM 310A is used to store various tokens. The tokens are generated by the speech processor 314 an correspond to the messages stored in RAM 310. The token synthesizer 308A is used for generating tokens corresponding to parts of simple, often repetitively structured phrases, e.g., those of a talking clock. Moreover, the summer 303 of Fig. 6 is omitted and a level adjustment-and-interleaving circuit 332 is provided for combining tokens corresponding to external speech with tokens from the message source 330A.

Thus, for the time-check function, the messages from source 330A correspond to the appropriate spoken time-check messages however they consist of signals which can be conveyed directly to the stimulation delivery module 318. When the timing signals from clock 328 match a

preselected event, the microprocessor instructs the message source 330A to issue the appropriate message token either from the token RAM 310A or token synthesizer 308A and to send the same to the interleaving circuit 332. This circuit interleaves the tokens from the message source 330A with the tokens from the speech processor 314 and sends the combined processed signals for stimulation by delivery system 318. The interleaving module superimposes the information derived from the message source 330A with that from the speech processor 314 so that the user can continue to partake in a conversation or listen to the radio, etc. while also hearing the private message, without loss of continuity. The combined signals are then applied to the nerve of the patient.

Of course, it is preferable that the patient be provided with a control means to either activate or deactivate the clock feature, or customize it for his own specific needs. In one embodiment, the command handset 323 is provided for this purpose. It generates a signal, for example a radio-frequency transmission, which is detected by the command decoder 324 and converted to a digital form that consists of a microprocessor instruction. The command handset 323 may include of one or more keys, depending on the range of the patient's required command repertoire. The simplest command may be an on/off command. For this purpose the command handset 323 is provided with a simple switch (not shown) which is activated by the patient to turn the timing feature in or off. For more complicated commands, such as for example, requesting a message at a particular time, or to set an alarm clock, the command handset is provided with a keypad and a display screen as discussed below.

Another function to be performed by the device is to store and selectively retrieve various messages and data such as reminder notes, telephone numbers, addresses and so on. This information may be entered via the remote control keypad and stored into message source 330 or 330A after appropriate conversion by the token synthesizer. The patent

may then retrieve and "hear" this information when demanded by means of the command handset 323.

As an example of the use of the control handset 323 to store the user's messages, suppose that it is desired to store the phone number of a friend. The user enters a command "Record Message" by means of the control handset 323. With reference to Fig. 7, this command is transmitted by the command handset 323 to the command decoder 324. The command decoder 324 decodes the command and informs the microprocessor 316 that subsequent microphone input is to be recorded. The microprocessor buffers the tokens received from the speech processor 314 and passes them to the message source 330A with an instruction or the memorandum tokens to be recorded.

Once the user has finished saying the telephone number, he sends the command "End Message" by means of the control handset 323. The command decoder 324 then flags the microprocessor 316 that a command has been received and acting on the command the microprocessor 316 terminates the recording. The microprocessor 316 then has the message source 330A issue the message "Message Recorded, Enter Message's Prompt". The user then types in a short phrase or mnemonic that he wishes to retrieve the phone number by, for example, "Peter's Phone Number" and then the instruction "Prompt Ends". Once this has been done the user may recall the phone number at a later time b typing "Recall Message" and then selecting the message's prompt by means of the display screen of the command handset 323.

Messages and commands may also be entered by the patient (or another person) via microphone 312. Of course for this function, the device must differentiate between commands/data from the patient and normal speech. This may be accomplished by activating a key on the command handset 323 prior to the command/data. Alternatively, the command decoder 324 may be used to recognise data received from the

microphone 310 via connection 301 (Fig. 6) rather than the command handset 323. If a certain code word/phrase from the microphone is recognized, the command recognition unit flags the microprocessor that following sounds contain data to be processed and stored in the message source 330, 330A.

Alternatively, the command decoder 324 may incorporate a speech recognition algorithm to recognize the wearer's voice, thereby further differentiating between ambient speech and commands and preventing inadvertent programming by unauthorised persons. For this purpose, the command decoder 324 receives the electrical signals from microphone 312 via connection 319 and transmits recognized commands to microprocessor 316 via a bus 324A.

As an example of the use of the speech recognition system to store the user's messages, suppose that it is desired to store the phone number of a friend. The user utters the command "Record Message". With reference to Fig. 7, this utterance is transduced by microphone 312 and conveyed by means of connection 319 to the command decoder 324. The command decoder 324 recognises the command and informs the microprocessor 316 that subsequent microphone input is to be recorded. The microprocessor 316 buffers the tokens received from the speech processor 314 and passes them to the message source 330A with an instruction for the memorandum tokens to be recorded.

Once the user has finished saying the telephone number he makes the utterance "End Message". The command decoder 324 then flags the microprocessor that a command has been received and acting on the command the microprocessor 316 terminates the recording. The microprocessor 316 then has the message source issue the message "Message Recorded, Enter Message's Prompt". The user then enters a phrase that he wishes to retrieve the phone number by, for example "Peter's Phone Number" and then the instruction "Prompt Ends". Once

this has been done the user may recall the phone number at a later time by uttering "Recall Message". The message source will then read through the list of message prompts until the user utters the command "Select" at which point the selected message will be recalled.

Other information may be transmitted in this manner to the patient as well. For example, the sensor 320 may be provided, which may be, for instance, a temperature sensor arranged and constructed to sense the subcutaneous temperature of the patient. To invoke thus function, the patient may request a temperature reading either by spoken word, or through the command handset 323. The sensor 320 generates an analog signal indicative of temperature and this signal is fed to the analog/digital converter 326. The resulting digital data is logged by the microprocessor 316.

The microprocessor 316 then requests an appropriate message from the message source 330A and the necessity tokens are conveyed to the level adjustment and interleaving nit 332 and thence to the stimulation and delivery module 318 which delivers stimulation to the patient. (In the embodiment of Fig. 6, appropriate messages are provided to summer 303).

Of course, other information may be sensed as well using an appropriate sensor in the place of sensor 318. For example, the sensing of the patient's blood pressure, or pulse rate may be facilitated. Moreover, other types of sensors may also be used for measuring parameters not directly related to the user's physiological condition such as an odometer for measuring walking or jogging distances.

The module 310 may also generate internal diagnostic reports. For instance a low battery level alarm can be implemented by any circuitry that provides a digital signal when the battery falls below a set threshold and delivering this signal to the microprocessor.

Alternatively, a convenient way of implementing such a facility using the system already depicted in Fig. 7 is to have the microprocessor

316 periodically request of the analog-to-digital converter 326, a power supply reading from power supply 336. If the battery reading is below a bottom limit, the microprocessor 316 will direct a "low battery" message to be conveyed from the message source 330A to the user.

Optionally, the patient may request a status report by depressing certain keys on the control handset 323, or by uttering certain command words. In response, the microprocessor 316 checks the status of its systems, including for example statistical information on error rates, volume levels, battery level, etc and provides a report to the patient by means of the message source 330A.

Referring now to Fig. 8, an embodiment is shown consisting of an external portion 340, and an internal or implanted portion 354. The external portion 340 includes a wearable speech processor housing 342 containing all the elements of the module 310 and command handset 323 of Fig. 6. External portion 340 also includes a microphone 344, and an inductive transmit coil 352. The microphone 344 performs the same function as microphone 312 and can be implemented as a so called behind-the-ear microphone.

In this embodiment, housing 342 includes a message screen 348 an a plurality of keys 350 provide the functionality of the command handset 323 in Fig. 6. The patient can enter various information or commands on the keys 350 and monitor and confirm the data entered from the keys 350 on screen 348. The screen 348 may display other information from the cochlear implant as well. The housing 342 is connected by cable 351 to the transmit coil 352.

The implanted portion 354 of the device includes a receiver housing 356. Included in the housing 356 is a receiver coil 358. A cable 360 extends from housing 356 into the middle ear of the patient terminating in cochlear electrode array 362 disposed adjacent to the basilar membrane

364, in the usual manner. The transmit and receive coils 352, 358 are arranged to provide inductive coupling therebetween.

In summary, in the embodiment of Fig. 8, the patient can transmit commands through buttons 350 and receive information either visually on screen 348 or, according to the present invention, as an aural perception through the cochlear electrode array 362.

The embodiment of Fig. 9 is different in that it shows a completely implanted cochlear device 370. The device 370 includes an internal housing 372 including a microphone 374 and an RF coil 376. Cable 360 extends from housing 372 and terminates with an array of electrodes 362 as described above.

For communication from the outside world, the device further includes a remote controller 378 which corresponds to the command handset 323 of Figs. 6 or 7. The controller 378 includes an RF coil 380 for communication by RF signals with the implant 372. The remote controller 378 also includes a screen 348 and keys 350. In this embodiment, the communication between the patient and the cochlear implant device 370 is accomplished by RF or similar means (eg, radar, ultrasound, etc.). In this embodiment, the module 310 is disposed in the housing 372, and the command handset 323 is implemented by the remote controller 378.

Of course, both embodiments of Figs. 8 and 9 may be implemented using either the arrangement of Fig. 6 or Fig. 7.

INDUSTRIAL APPLICABILITY

The apparatus of the invention may be used to control the operation of a cochlear implant.

CLAIMS

1. A device for aiding a person having a hearing impairment, said device comprising:

a microphone for converting ambient sounds and commands including voice commands and other audio signals to electrical signals;

signal processing means for processing said electrical signals in accordance with control signals;

means for transmitting processed signals to said person; and

command recognition means coupled to said microphone for recognizing said voice commands and wherein said recognition means generates said control signals.

2. The device of claim 1 wherein said signal processing means includes a volume control for controlling the volume of the processed signals for said person and wherein said control means is capable of being adjusted by said control signals.

3. The device of claim 1 wherein signal processing means includes means for converting said electrical signals into aural stimulating signals selectively in accordance with one of a first and a second set of criteria, wherein said control signals define the selected criteria.

4. The device of claim 1 further including a battery for providing power to said device, means for monitoring a status of said battery, means for generating an oscillating signal and superimposing means for superimposing said oscillating signal on said electrical signals to indicate said status.

5. The device of claim 4 wherein said command recognition means recognizes a battery status command, said command recognition means generating a battery status control signal responsive to said battery status

command, said battery status control signal enabling said superimposing means.

6. A device for aiding a hearing impaired person; said device comprising:

an external section worn by said person; and

an internal section implanted in said person;

said external section including a microphone receiving audio signals and converting them into received electrical signals, signal processing means for processing signals into stimulation signals, transmitting means for transmitting said stimulation signals to said internal section, a battery for generating power to said external section, and means for reporting a status of said battery;

said reporting means including monitoring means for monitoring said battery, signal generating means coupled to said monitoring for generating battery status signals indicative of said status and means for combining said battery status signals and said stimulation signals for indicating to said person said battery status.

7. The device of claim 6 wherein said external section further comprises command receiving means for receiving a command from said person, said command receiving means activating said reporting means.

8. The device of claim 7 wherein said command receiving means is arranged and constructed to receive spoken commands.

9. The device of claim 7 wherein said processing means process said electrical signals in accordance with control signals, wherein said control signals are generated by said command receiving means in response to commands from said person.

10. The device of claim 9 wherein said commands are spoken commands.

11. The device of claim 9 wherein said processing means includes a volume control circuit for adjusting a volume of said stimulating signals in response to a volume command.

12. The device of claim 9 wherein said processing means process said signals in accordance with one of a first and a second conversion criteria, said processing means including selection means for selecting said conversion criteria in accordance with said commands.

13. A hearing aid system comprising:

means for receiving ambient and command signals and converting said signals into electrical signals;

means for separating said electric signals into audio signals and command signals;

means for processing said audio signals to generate audio stimulating signals;

means for controlling said processing signals in accordance with said command signals; and

means for transmitting said stimulating signals to the cochlear nerve of a patient.

14. The system of claim 13 wherein said command signals are voice commands.

15. The system of claim 14 wherein said means for controlling include command recognition means for recognizing said oral commands.

16. The system of claim 14 wherein said controlling means includes storing means for storing a plurality of test words and comparing means for comparing said commands to said test words to identify a particular command with a function of said system.

17. The system of claim 16 wherein said test words include words designating one of a battery check function and a volume control function.

18. The system of claim 15 wherein said processing means includes a first module for processing said audio signals in accordance with a first criteria and a second module for converting said audio signals in accordance with a second criteria, said system including module selecting means for selecting one of said modules, said selecting means being controlled by one of said commands.

19. A cochlear implant system comprising:

means for sensing ambient sounds and generating in response first electrical signals;

event means for sensing events other than said ambient sounds and generating in response second electrical signals;

means for generating processed signals corresponding to said first and second electrical signals; and

stimulating electrodes for applying said processed signals to an auditory nerve so that the patient can perceive said ambient sounds and receive information regarding said events.

20. The system of claim 19 further comprising memory means for storing a preselected message corresponding to one of said events, said

stimulating electrodes applying stimulating signals corresponding to said message.

21. The system of claim 20 wherein said message comprises processed message signals suitable for application by said electrodes.

22. The system of claim 19 wherein said event means comprises an internal sensor for determining an internal condition of said system and for generating a signal indicative of said internal condition.

23. The system of claim 22 further comprises a power source for providing power to the system and wherein said internal sensor monitors said power source.

24. The system of claim 19 wherein said even means comprises a sensor for sensing an external condition and for generating a signal indicative of said external condition.

25. The system of claim 24 wherein said sensor is constructed and arranged to sense exercising by said patient.

26. The system of claim 24 wherein said external sensor senses speech by said patient.

27. The system of claim 26 wherein said memory means stores a reminder message corresponding to said speech.

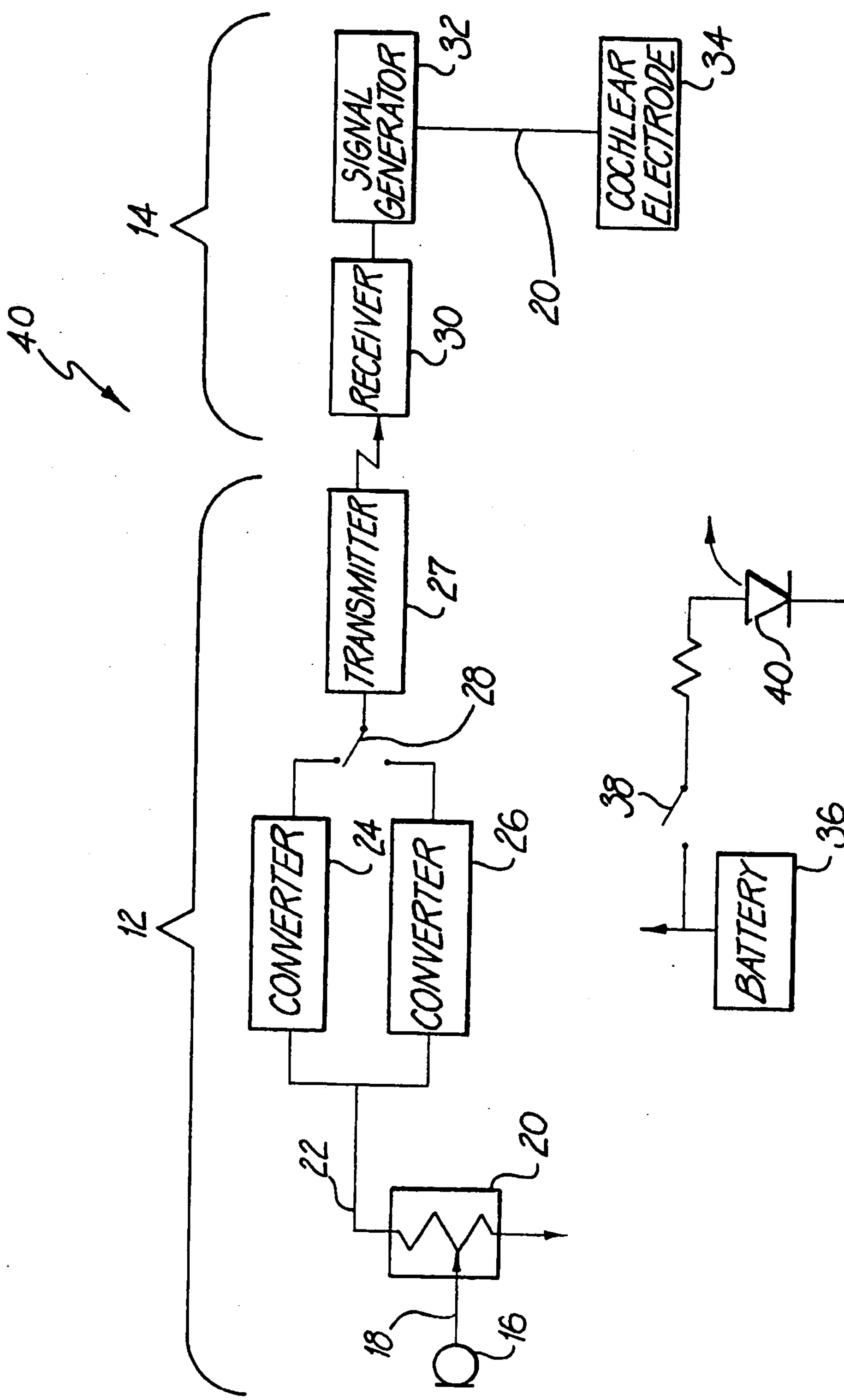

SIGNAL GENERATOR
COCHLEAR ELECTRODE
RECEIVER
TRANSMITTER
CONVERTER
CONVERTER
BATTERY

FIG.1

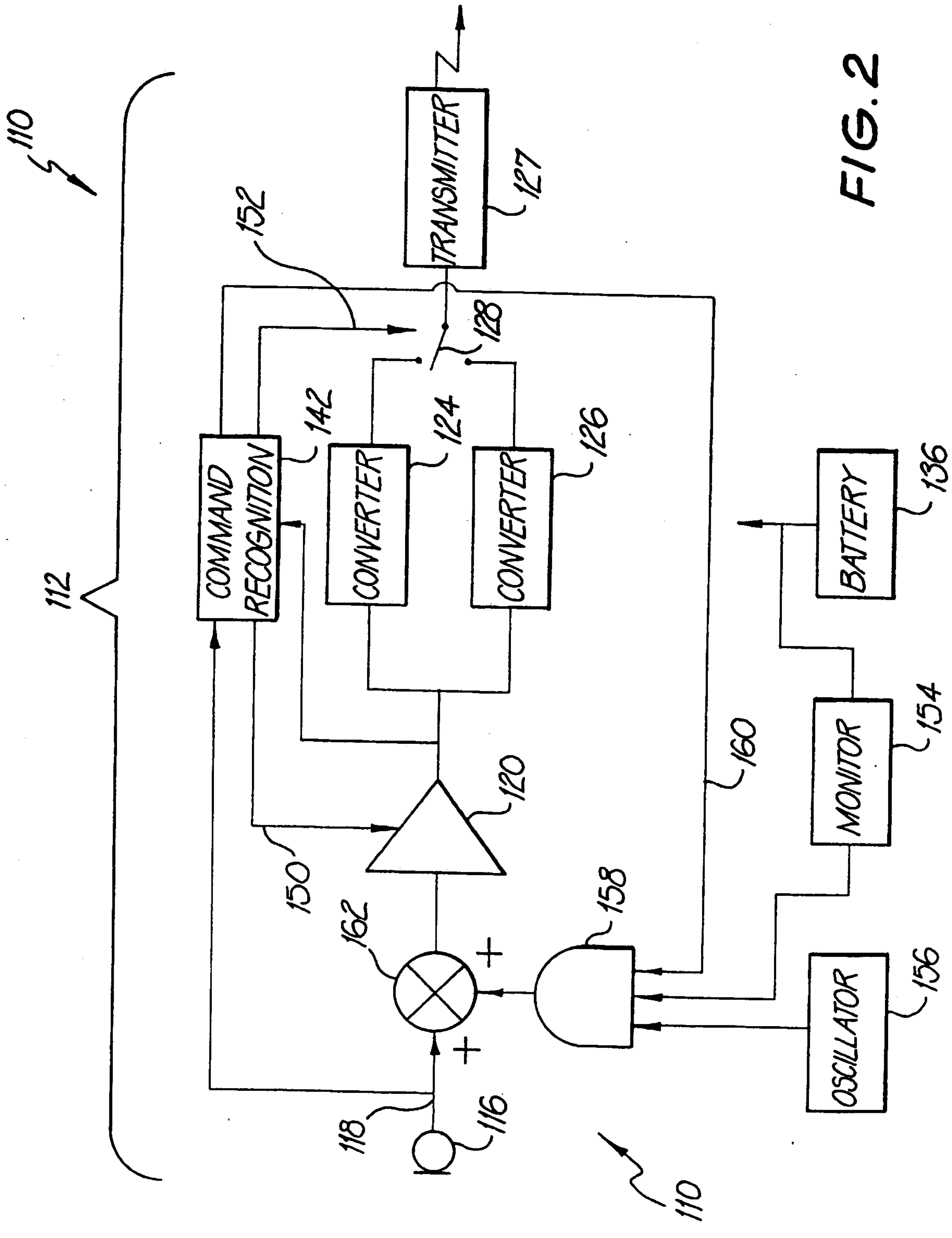

110
112
TRANSMITTER
127
152
128
COMMAND RECOGNITION
142
CONVERTER
124
CONVERTER
126
BATTERY
136
MONITOR
154
160
120
150
162
158
OSCILLATOR
156
118
116
110

FIG. 2

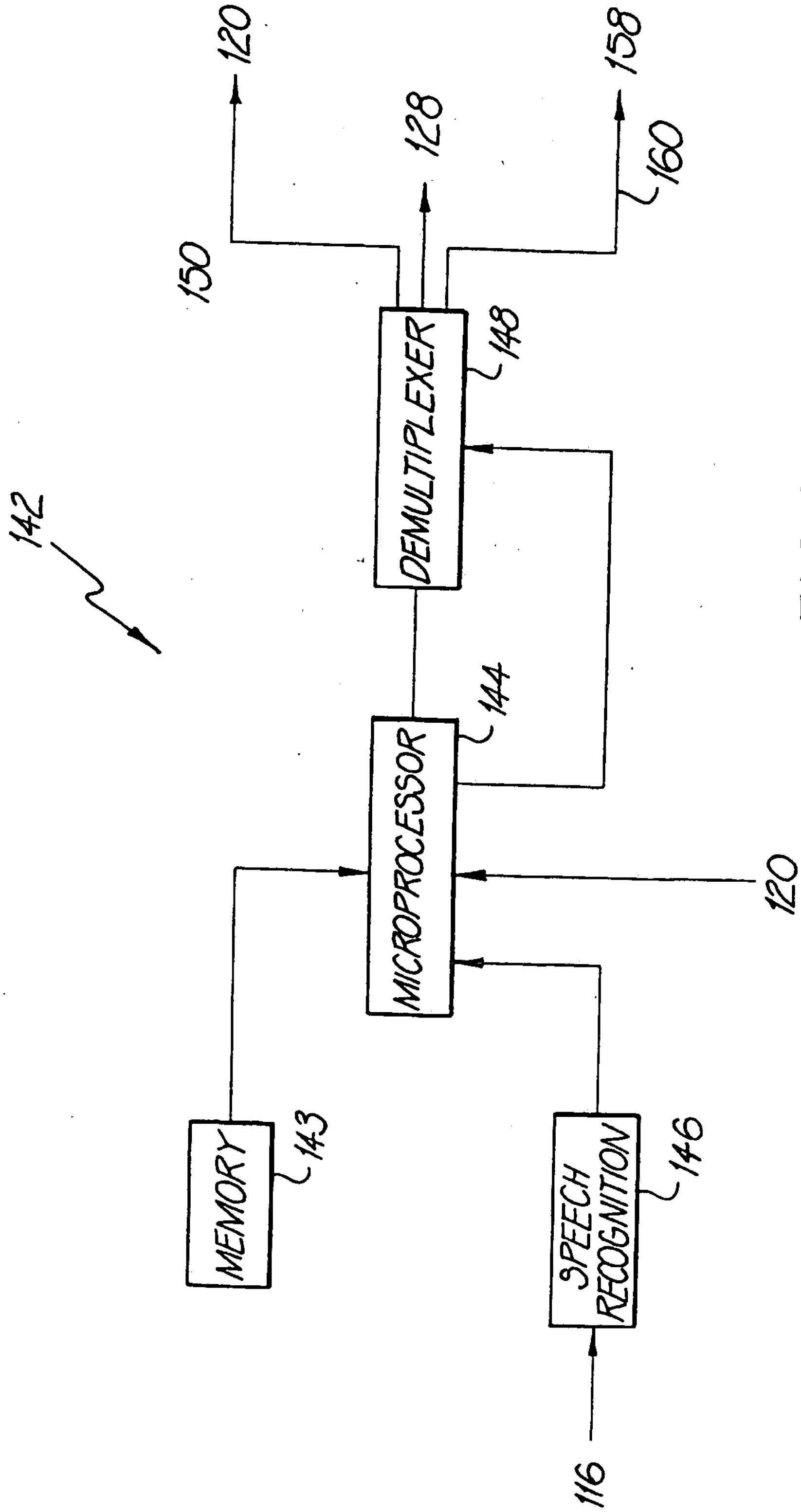

142
MEMORY
143
SPEECH RECOGNITION
146
116
MICROPROCESSOR
144
120
DEMULTIPLEXER
148
150
120
128
158
160

FIG.3

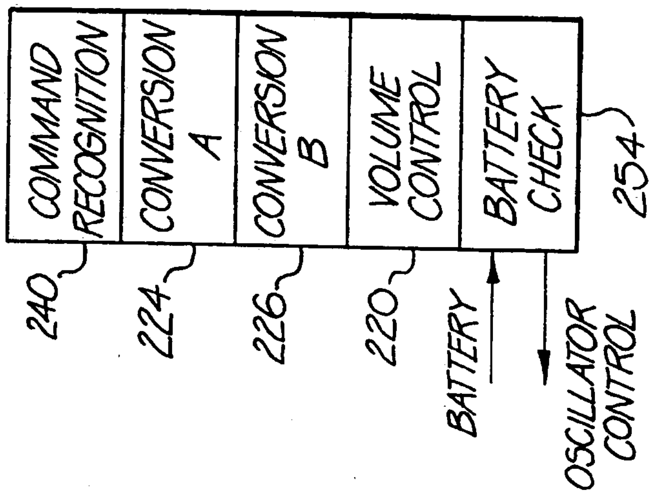
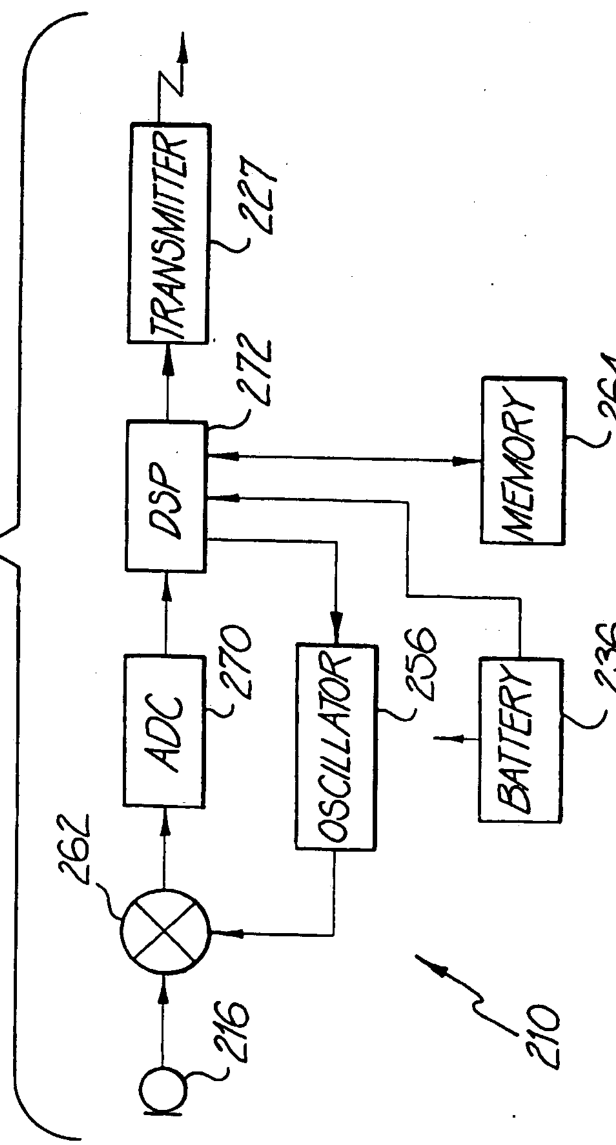

COMMAND RECOGNITION
CONVERSION A
CONVERSION B
VOLUME CONTROL
BATTERY CHECK
240
224
226
220
254
BATTERY
OSCILLATOR CONTROL

FIG. 5


212
TRANSMITTER
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DSP
272
MEMORY
264
ADC
270
OSCILLATOR
256
BATTERY
236
262
216
210

FIG. 4

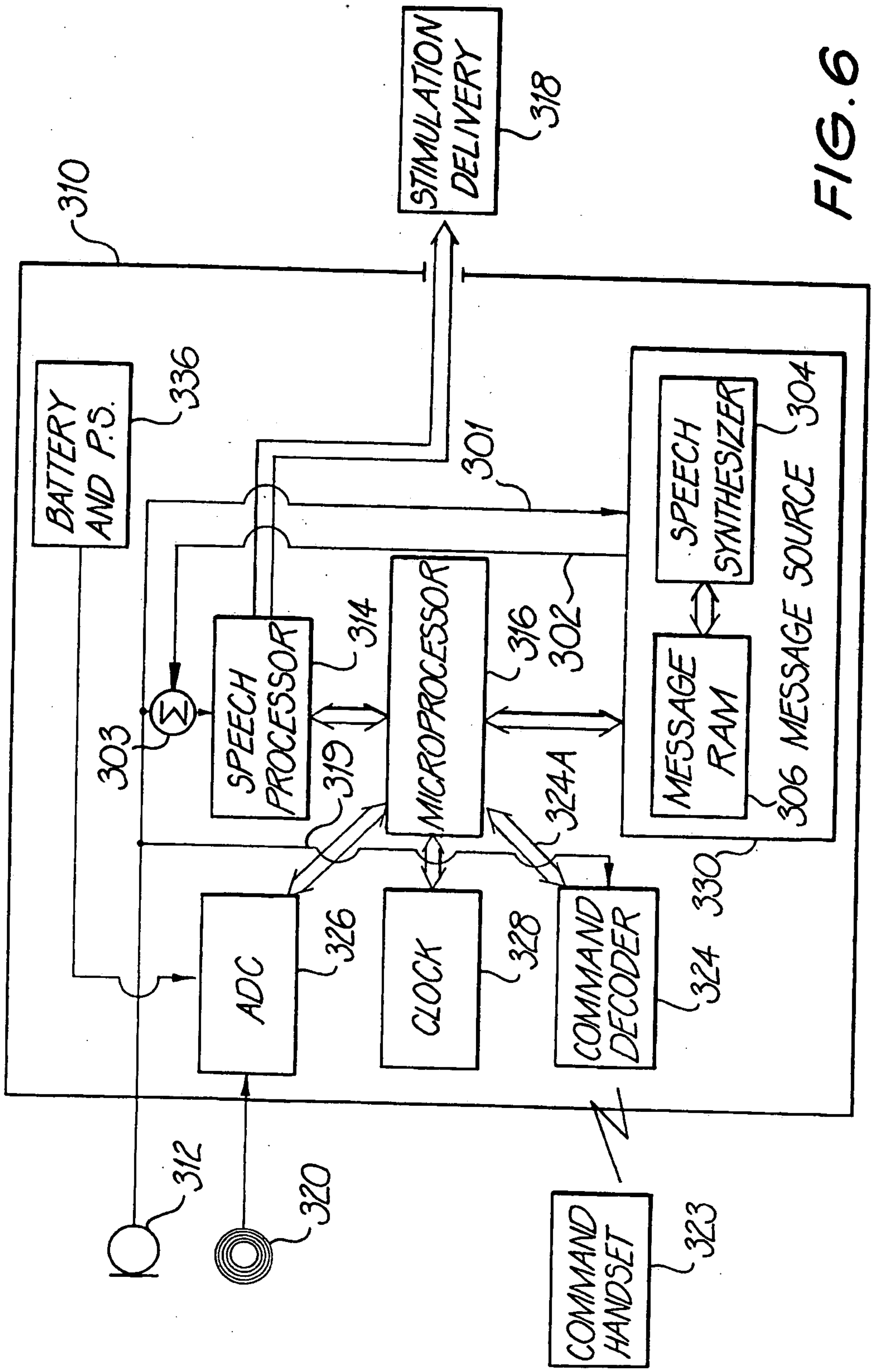

310
STIMULATION DELIVERY
318
BATTERY AND P.S.
336
301
SPEECH SYNTHESIZER
304
303
SPEECH PROCESSOR
314
MICROPROCESSOR
316
302
319
324A
MESSAGE RAM
306 MESSAGE SOURCE
330
ADC
326
CLOCK
328
COMMAND DECODER
324
312
320
COMMAND HANDSET
323

FIG. 6

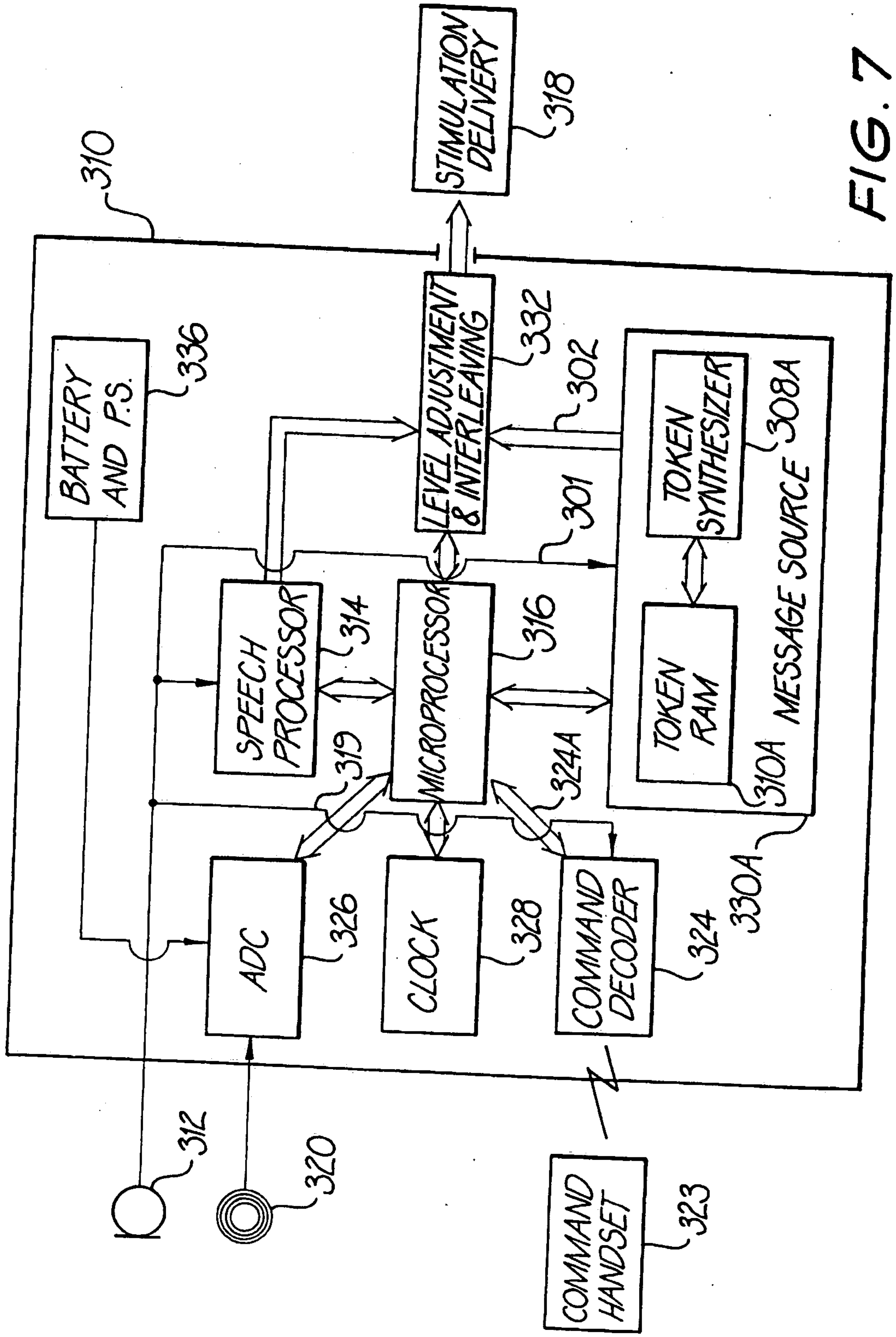
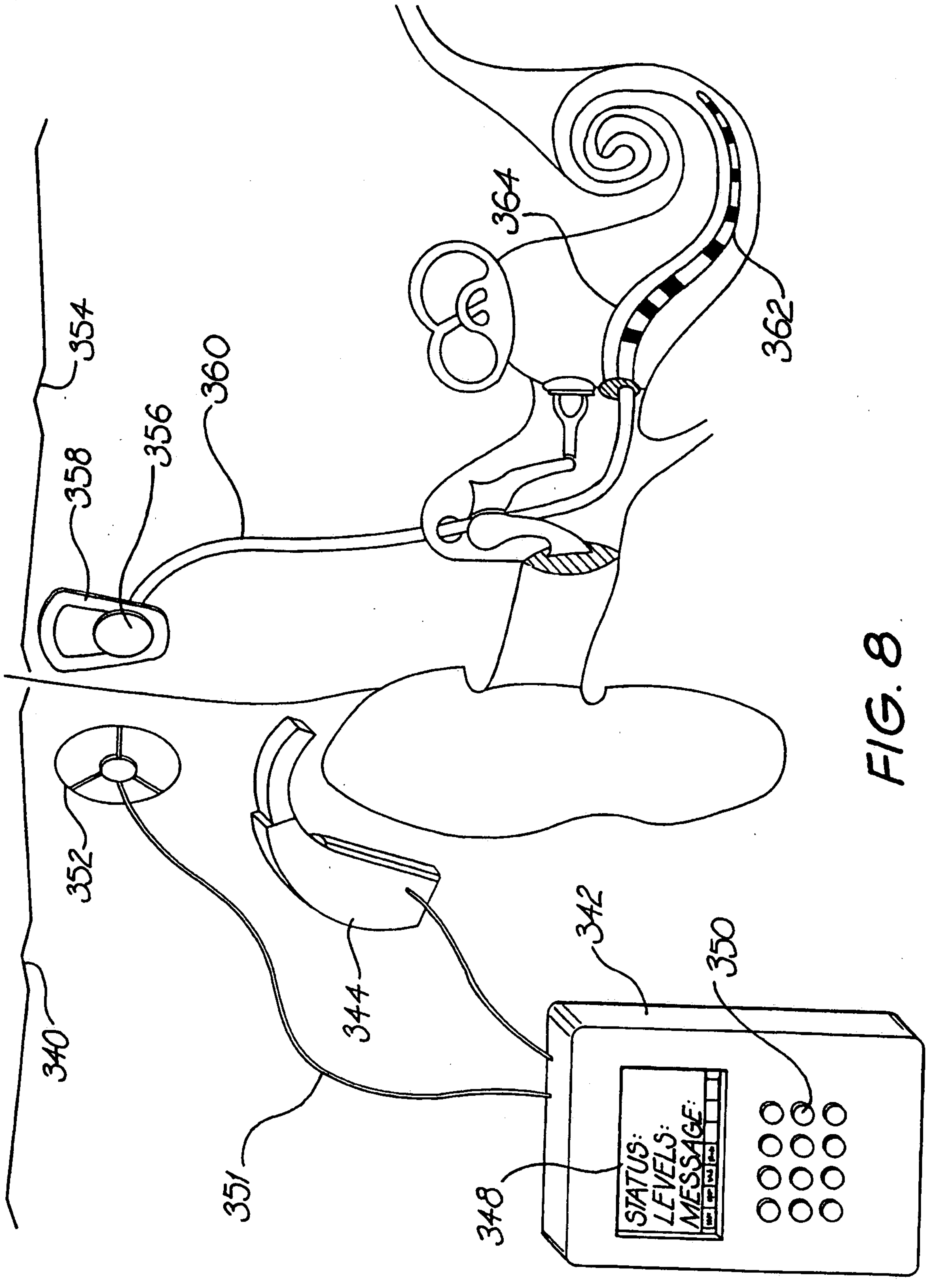

STIMULATION DELIVERY
318
310
BATTERY AND P.S.
336
LEVEL ADJUSTMENT & INTERLEAVING
332
302
TOKEN SYNTHESIZER
308A
301
SPEECH PROCESSOR
314
MICROPROCESSOR
316
TOKEN RAM
310A
MESSAGE SOURCE
319
324A
330A
ADC
326
CLOCK
328
COMMAND DECODER
324
312
320
COMMAND HANDSET
323

FIG. 7


340
342
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348
350
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352
354
356
358
360
362
364
STATUS:
LEVELS:
MESSAGE:

FIG. 8

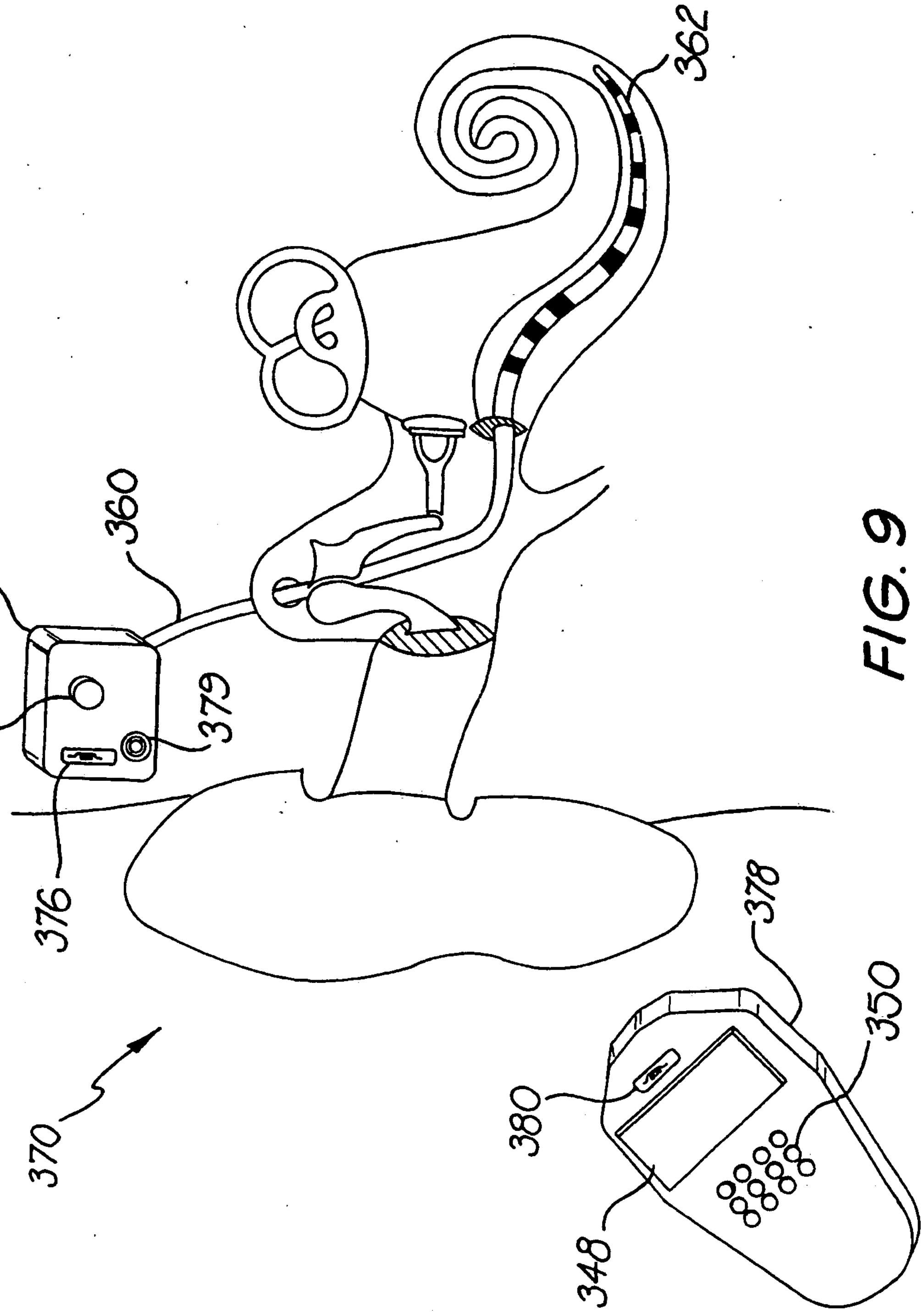

FIG. 9

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00403

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl^6: A61F 11/04, H04R 25/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC A61F 11/04, H04R 25/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT: voice# or command# or status or event# or batter:
JAPIO: voice# or command# or status or event# or batter:

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, A	EP 707433 A (MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD) 17 April 1996 Figure 3, column 6 line 5 -column line 40	1-27
P, X	WO 96/06586 A (FRAUNHOFER - GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG E.V.) 7 March 1996 Figure 1	19
A	US 4790019 A (HUEBER) 6 December 1988 Figure 2, column 3 line 66 -column 5 lne 3	1-27

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 13 August 1996	Date of mailing of the international search report 30 AUG 1996
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	Authorized officer J. LAW Telephone No.: (06) 283 2179

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 96/00403

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	9606586	AU	22127/95				
EP	707433						
US	4790019	AT	379929	DE	3573701	DK	163632
		EP	168895	JP	3068600		

END OF ANNEX